

GAO

Fact Sheet for the Chairman,
Subcommittee on General Oversight and
the Economy, Committee on Small
Business
House of Representatives

March 1986

RESEARCH AND DEVELOPMENT

A Profile of Selected Firms Awarded Small Business Innovation Research Funds





UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

RESOURCES, COMMUNITY,
AND ECONOMIC DEVELOPMENT
DIVISION

March 21, 1986

B-209790

The Honorable Nicholas Mavroules
Chairman, Subcommittee on General Oversight
and the Economy
Committee on Small Business
House of Representatives

Dear Mr. Chairman:

Due to your office's interest in our work concerning small business innovation research, we briefed your staff on November 21, 1985, as requested. The briefing concerned interviews that we had conducted with 19 small, high-technology firms participating in the Small Business Innovation Research (SBIR) program. We contacted these firms in the course of developing a questionnaire designed to collect information on the implementation of the Small Business Innovation Development Act of 1982. At the briefing, your staff requested that we prepare a written document on the information we had presented. As agreed, this fact sheet summarizes that information.

In developing the questionnaire, we administered a structured interview to company officials at the 19 firms. We judgmentally selected the firms on the basis of their proximity to our San Francisco Regional Office, where we developed the questionnaire. Consequently, our sample is not representative of all firms participating in the SBIR program. The questionnaire will be administered within the next few months to a larger, more representative sample of firms participating in the SBIR program.

We also interviewed officials at eight venture capital firms and three experts on small business innovation to get their opinions on the availability of venture capital for new and small businesses participating in the SBIR program.

The SBIR recipients we interviewed were generally satisfied with the program since it helped support their research and development (R&D) efforts. One of the 19 firms contacted had

developed commercially viable products using SBIR-funded technology. Also, most firms had contacted private companies regarding the commercial potential of their SBIR projects, and some recipients had received private company pledges of capital investment in the final design, testing, and commercialization of their new products and services. However, the venture capitalists we interviewed described some difficulties relating to the availability of venture capital for commercializing SBIR projects.

Our fact sheet provides background information on the SBIR program, a description of our scope and methodology, a profile of the SBIR recipient firms interviewed, and some examples of their SBIR experiences and projects. The fact sheet also describes efforts made by recipients to obtain other funds and to commercialize their SBIR projects.

As arranged with your office, we are sending copies of this fact sheet to the federal departments and agencies that administer SBIR programs, to the firms that provided us information, and to other interested parties upon request. If you have additional questions or if we can be of further assistance in this matter, please contact me at (202) 275-7783.

Sincerely yours,


Sarah P. Frazier
Associate Director

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ABBREVIATIONS

DOD	Department of Defense
DOE	Department of Energy
MHD	magnetohydrodynamic
NSF	National Science Foundation
R&D	research and development
SBA	Small Business Administration
SBIR	Small Business Innovation Research

SECTION 1:

INTRODUCTION

The Small Business Innovation Development Act of 1982 (Public Law 97-219) is designed to strengthen the role of small, innovative firms in federally funded research and development (R&D) programs. It requires federal agencies with budgets of \$100 million or more for R&D performed by parties outside the agencies to set aside specified percentages (up to 1.25 percent) of this budget to fund a Small Business Innovation Research (SBIR) program. The program's objectives are to

- stimulate technological innovation,
- use small business to meet federal R&D needs,
- increase private-sector commercialization of innovations derived from federal R&D, and
- foster and encourage minority and disadvantaged persons to participate in technological innovation.

Each agency participating in the SBIR program must follow a three-phase funding process. Each year the agency solicits project proposals and selects a limited number for Phase I funding. During this first phase, the agency awards a firm limited funding (usually \$50,000 or less) over a short time (normally 6 months or less) to demonstrate the feasibility of a proposed project. The agency selects a limited number of completed Phase I projects for Phase II, during which the agency awards additional funds (usually \$500,000 or less) over a 1- to 2-year period to carry out the principal research or R&D efforts. In the third phase, firms are expected to commercialize their new technologies through non-federal sources or, if appropriate, through traditional (non-SBIR) federal agency procurement programs. No SBIR funds may be used during the third phase.

During SBIR's first year (fiscal year 1983), federal agencies made 760 awards to small firms participating in the SBIR program. In fiscal year 1984 (the latest year for which complete data is available), agencies made 1,337 awards to participating small firms. The agencies obligated approximately \$44.5 million for fiscal year 1983 SBIR awards and about \$111.5 million for fiscal year 1984 awards. The Small Business Administration (SBA) estimates that SBIR awards will be about \$500 million annually by fiscal year 1988--the last year for SBIR programs unless the act is reauthorized.

SCOPE AND METHODOLOGY

As part of our continuing assessment of the implementation of the Small Business Innovation Development Act, we are preparing a questionnaire to be administered to a representative sample of

firms participating in the SBIR program. In developing this questionnaire, we conducted interviews at 19 small, high-technology firms participating in the SBIR program. All of these companies are located in the San Francisco area, in close proximity to our San Francisco Regional Office, where we developed the questionnaire. Our sample of 19 firms was judgmental and is not representative of all firms participating in the SBIR program.

Based on the interviews conducted during the questionnaire development, we

- developed a profile of the 19 firms,
- obtained a description of their research work and experiences with the SBIR program, and
- identified efforts these firms were making to commercialize products or services developed with SBIR funding.

The information we collected was from firms receiving awards in fiscal years 1983 and 1984. To obtain additional information about commercialization of products developed with SBIR funding, we interviewed officials at eight venture capital firms and three experts on small business innovation.

SECTION 2:

PROFILE OF 19 SBIR RECIPIENTS

The group included firms in such diverse high-technology areas as medical technology, energy research, biotechnology, computer systems and software development, equipment instrumentation and sensing devices, and laser engineering. Awards to each firm varied in number from one to twelve. The 19 firms received 59 SBIR Phase I and Phase II awards during fiscal years 1983 and 1984, totalling \$5.4 million in SBIR funds.

Employment at the firms ranged from two persons (both of whom worked part-time on an SBIR project) to 190 full-time and part-time employees (of which 4 to 6 employees were assigned to two SBIR projects). The 19 firms employed an average of 33 employees. The firms' average age was 6.6 years. The oldest firm was established in 1967, and the newest firm was established in 1983.

While SBIR awards represented the first successful effort to obtain R&D funding from a federal agency for eight firms, no firm depended solely on SBIR funds for its income. Officials of the firms told us that other sources of income included non-SBIR government contracts, commercial contracts, or outside employment. Total sales revenues for each firm ranged from 0 to 8 million dollars in fiscal year 1984 and from 0 to 15 million dollars in fiscal year 1985.

Table 2.1 profiles the 19 firms where we conducted interviews to obtain information. Table 2.2 indicates the diverse areas of research and project types funded by the SBIR program in these 19 firms. Abbreviated case studies at the end of this fact sheet provide examples of this diversity (see pages 11 through 14).

Table 2.1: Profile Statistics on SBIR Recipients We Interviewed

<u>Firm</u>	<u>Year firm estab- lished</u>	<u>Number of employees</u>	<u>Sales revenues (\$ millions)</u>		<u>Number of FY83&FY84 SBIR awards</u>	<u>Total dollar value of SBIR awards</u>
			<u>FY84</u>	<u>FY85 (to date)</u>		
1	1977	42	2.8m	4.5m	12	\$948,897
2	1978	45	2.8m	2.3m	6	703,024
3	1982	31	a	1.9m	5	646,438
4	1980	10	0.2m	a	2	512,797
5	1980	30	a	2.4m	6	423,589
6	1980	45	1.7m	1.0m	3	364,062
7	1981	4	a	0.39m	3	349,998
8	1983	7	0.86m	0.282m	4	335,469
9	1977	80	7.2m	1.7m	4	263,013
10	1973	19	4.0m	0.595m	2	253,991
11	1980	190	8.0m	15.0m	2	138,449
12	1967	14	1.0m	0.3m	2	99,992
13	1980	39	3.2m	1.0m	1	69,499
14	1979	3	0.0m	0.0m	2	67,183
15	a	a	a	a	1	62,640
16	1981	2	0.0m	0.0m	1	56,000
17	1980	22	1.0m	a	1	50,000
18	1972	5	0.443m	0.109m	1	48,769
19	1981	7	0.0m	0.0m	1	33,560

^aThese statistics were not readily available at the time of our visit.

Table 2.2: Description of Selected SBIR Projects at the Firms We Visited

<u>Project title</u>	<u>Topic area</u>	<u>R & D objective</u>	<u>Funding agency</u>	<u>Award amount</u>
Rapid Diagnosis of Leishmania Species using Specific DNA Hybridization	Biotechnology	Develop diagnostic tests and kits for the treatment of the parasitic disease Leishmania.	DOD	\$ 49,750 Phase 1
Development of Improved Magnetic Fusion Plasma X-ray Diagnostics Using the Layered Synthetic Micro-structure (LSM) for TFTR Application area.	Instrumentation	Demonstrate the feasibility of using the newly-developed LSM X-ray optical component as the basis for improved radiation hardened, magnetic fusion energy plasma diagnostic instrumentation.	DOE	49,997 Phase 1
Research on the Correlation between Electrostatic Field Integrity and the Performance of Electron Guns	Electronics Engineering	Determine impact of high-precision electron gun on beam quality.	DOD	185,000 Phase 2
Development of an Integrated Waste Water Treatment/Purification System	Environmental Protection	Develop waste water treatment and purification system to handle liquid domestic, industrial, and medical waste.	DOD	48,504 Phase 1
Coding for Band-Limited Channels	Data Communications	Construct, debug, and test an experimental encoder-decoder modem to demonstrate use of electromagnetic spectrum on band-limited telecommunication channels.	NSF	103,570 Phase 2
Application of Two-Phase Flow and Heat Transfer Correlations to Zero Gravity Conditions	Energy Use	Study and advance the understanding of two-phase heat transfer under zero gravity.	DOD	37,592 Phase 1

SECTION 3:

RECIPIENT FIRMS' EFFORTS TO COMMERCIALIZE

RESULTS OF THEIR SBIR WORK

Little information about the commercialization of technologies developed with SBIR funding is available at present--the program is only in its third year. Although the National Science Foundation (NSF) and the Department of Defense (DOD) made a few Phase II awards in fiscal year 1983, Phase II awards were not generally granted until fiscal year 1984. Eleven of the 19 firms at which we conducted our interviews received Phase II awards in fiscal years 1983 or 1984.

Of the firms that we surveyed, one had developed or sold commercially viable products using technology developed with SBIR funding. Most of the other firms were trying to attract private-sector financing for project marketing, production, and distribution. Many company officials, however, believed that it was still too early to estimate when they would actually be marketing products developed with SBIR funding. Some had received private company pledges of capital investment in the final design, testing, and commercialization of their new products or services. Such pledges were usually contingent upon the recipient firm meeting certain guidelines as established in a memorandum of understanding or other agreement with the private company. Recipient firms had also used licensing agreements or had given options for ownership as a means of securing private sector financing for commercialization. Case examples 4 and 5 illustrate some of the arrangements made to commercialize SBIR products or services. (See pages 13 and 14.)

SECTION 4:

AVAILABILITY OF VENTURE CAPITAL FINANCING

Officials at eight venture capital firms in the San Francisco area told us that small firms may have difficulty obtaining venture capital financing for two reasons. First, competition for and cost of venture capital is high and, second, venture capitalists usually want to support product development rather than product research.

Officials at two of the four venture capital firms that were familiar with the SBIR program emphasized that SBIR award winners do not receive special treatment when investment decisions are made, and that competition is very stiff. The key factors considered in determining whether to provide capital are the firm's product and the apparent strength of its management team.

Small business representatives and officials at venture capital firms informed us that, in exchange for capital, a venture capital firm may require a significant share of the business as compensation for undertaking the investment risk. According to one survey of firms awarded SBIR funds, few of these firms have, in fact, made this trade-off.¹ The study revealed that 70 percent of the SBIR firms surveyed had relinquished less than 10 percent of their firm's ownership to nonemployees (including venture capital firms). For over half the SBIR firms, the major source of private sector financing was a licensing agreement with a large manufacturer or a bank loan. It is not clear from the survey whether these firms had an opportunity to trade equity for capital.

Another possible source of capital is investment by larger companies involved in similar or related fields. One SBIR firm in our sample, which specialized in the design and sale of lasers and related equipment, found this to be so. The firm obtained an SBIR Phase I award to examine the feasibility of using a new type of laser in treating cancer tumors growing on internal organs. After the results of its Phase I work appeared promising, the company was subsequently acquired by a larger firm specializing in medical laser equipment. The parent company is now supporting the additional work necessary to develop and commercialize the new technology.

¹Peat, Marwick, Mitchell, and Company, Results--Survey of SBIR Grant Award Winners, August 8, 1985.

SECTION 5:

EXAMPLES OF RECIPIENT FIRMS' SBIR PROJECTS AND COMMERCIALIZATION EXPERIENCES

The following examples illustrate the diversity of SBIR awardees, projects, and their different modes of operation. Examples of efforts to commercialize SBIR results are also given.

DIVERSITY OF SBIR RECIPIENTS

Example 1: Platelet Separation

This small medical and biotechnology firm, established in January 1981, received a Phase I award from the Public Health Service to further develop and test two improved methods for processing donated blood to remove platelets. Platelets are used in blood transfusions to control patient bleeding. The firm hoped to develop new devices for separating the platelet-rich plasma components out of whole blood more efficiently and with greater purity. This SBIR project was the company's first R&D award from the federal government.

Both of the firm's co-founders were concurrently employed at a medical research institute. As the only employees of the firm, they served as principal investigator and senior scientist on the SBIR project. The firm leased space from the medical research institute to carry out the SBIR research work.

The Phase I project was terminated with inconclusive results, according to the project official we contacted. We were told that the firm initially encountered problems in testing a prototype of one device because it could not locate a company to manufacture certain equipment needed to test the prototype. After building and testing the prototype of a second device, they told us that the firm encountered problems getting the device to operate properly. After considering these problems, the firm decided to discard the second prototype.

The investigators submitted a proposal for Phase II funding to produce the type of equipment required to test their first prototype and to carry out the remaining work needed to demonstrate this approach. That proposal, however, was not funded. The project's principal investigator indicated that he and his co-investigator would continue limited work on the project since both have access to equipment and facilities at the medical research institute. At the time of our interview, no final report had been prepared on this project.

Example 2: Pulsed Plasma Magnetohydrodynamic Technology

This firm has focused its efforts on developing "pulsed plasma magnetohydrodynamic" (MHD) technology, largely with funding from the U.S. Office of Naval Research during the past 8 years.

This technology has the potential to provide compact, portable, lightweight devices for generating the high levels of energy and power needed in advanced defensive electronic countermeasure and early warning systems.

The firm was established in 1972. It has one part-time and four full-time employees. It has completed several defense related R&D projects. Between fiscal year 1981 and fiscal year 1985 the firm received 10 contracts from government agencies and 15 contracts from other sources. Company officials said that these contracts totalled \$1.8 million in government awards and \$180,000 in awards from other sources.

Officials of the firm stated that winning an SBIR award to continue work on pulsed plasma MHD has been a significant factor in the firm's survival since 1983, when the Department of Defense terminated two programs that would have provided large government contracts. While the Phase I project (funded by the Air Force) provided some revenues during 1983, it was completed late that year. By the end of May 1984, the firm had run out of money, and company officials decided to close the firm down. Subsequently, in September 1984 company officials submitted a Phase II proposal for the SBIR project; they received an award in January 1985. Once negotiations were completed for the Phase II award, company officials found new office space and reopened.

Winning the Phase II award motivated the company to pursue commercial applications for this technology and stimulated private sector interest in its work. One company paid the firm a licensing fee for the pulsed plasma MHD technology, and another expressed interest in commercial applications of the technology. In April 1985, principals of the firm set up another company to help market the new power supply technology to firms in the petroleum and mineral industry.

Example 3: Agar Production

This firm is a marine biotechnology company founded in 1981 to develop, produce, and market products derived from marine organisms. The firm has concentrated on the production of agar and its more purified form, agarose, from seaweed. Agar is currently the most important bacteriological and tissue culture medium available for use in laboratories operated by hospitals, universities, and industrial biomedical research firms. Agarose is used for a variety of analytical research procedures in the biotechnology industry. The firm received a Phase I award from NSF in 1983 to study the feasibility of developing and growing superior strains of agar.

Company officials view the agar project as a long-term venture. The firm has not yet reached the point where it is producing products for sale. The firm has been operating on about \$600,000 received from investors. The SBIR grant is the firm's first revenue from the federal government.

Officials of the firm submitted a Phase II proposal to continue their work and the firm's shareholders agreed to match the award. At the time of our work, the project had not been approved for Phase II funding.

EXPERIENCE WITH EFFORTS TO COMMERCIALIZE SBIR RESULTS

Example 4: Investment Company as a Source of Funding for Full Development

This firm received a Phase II SBIR award to demonstrate the feasibility of using an electron-beam system to recrystallize encapsulated silicon particles into single sheets of crystal. (The semi-conductor industry uses such sheets as base material for forming single transistors and integrated circuit components found in many electronic products.) The SBIR recipient firm and a small business investment company signed a memorandum of understanding under which the investment company will provide \$400,000 to the SBIR recipient for the final design and commercialization of the SBIR project. The funding is contingent upon the recipient successfully completing Phase II, demonstrating the marketability of the SBIR project's technology, and obtaining letters of intent or purchase orders from at least two manufacturing firms. Under SBA regulations, the investment company must obtain approval from SBA's Investment Division to make the investment since it is a small business investment company licensed by SBA.

The investment company made the follow-on funding commitment in order to be accorded first option for investing in the recipient's project and the opportunity to participate in the successful development of a new technology. The SBIR recipient entered the agreement in order to obtain a funding commitment that will permit the full development, testing, and marketing of the new technology and to benefit from the investment company's contacts and management assistance.

Example 5: Marketing of New Products to the Federal Government and Private Industry

This SBIR recipient is a small but growing company which has already begun to market new products incorporating some of the technology developed with SBIR funding. The company is developing and selling error correction systems to improve the quality of computer data transmitted from one location to another by eliminating data transmission errors.

The company has received two SBIR Phase II awards from NSF. One of the firm's projects was to explore new methods for handling "noise bursts," which create periodic errors in computer transmissions. Such bursts of noise are also commonly used to jam communications equipment and other electronic gear. During Phase I, the company documented the ability of its proposed system to

handle larger bursts of noise while reducing data errors. The firm received Phase II funding to develop and test a prototype system.

This firm has already marketed new products incorporating some of the technology developed with SBIR funding. The Air Force was evaluating two of the firm's machines for possible purchase, and the firm had sold a number of units to a large telecommunications firm and to the State Department. Company officials were concentrating on marketing their firm's improved technology to large users of leased transmission lines, who typically pay \$15,000 to \$20,000 a month in lease charges. Company officials expect that mass production of the new system should enable them to reduce unit costs so they can begin marketing to small computer users.

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